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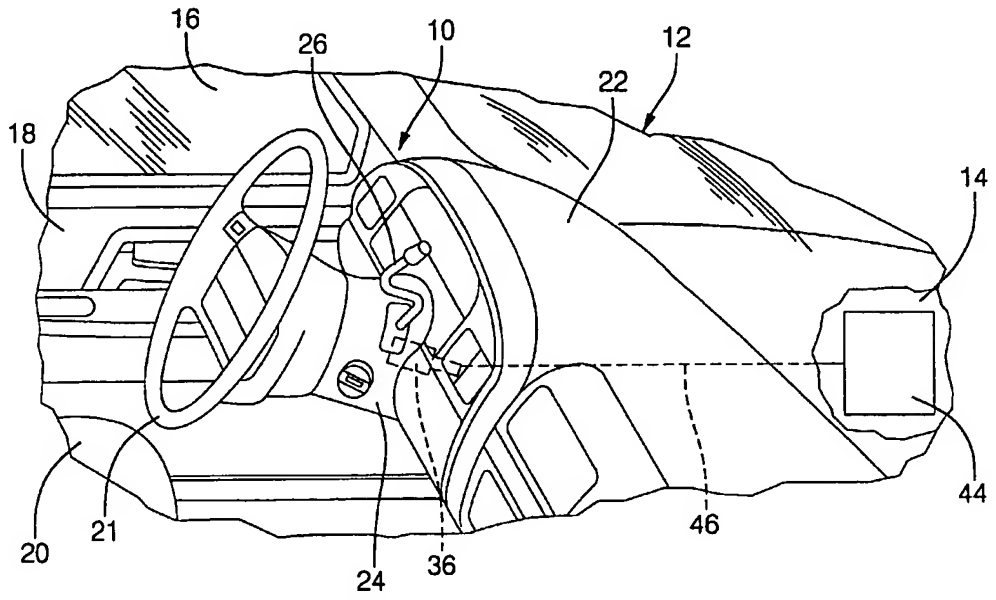
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: DAMPED STEERING ASSEMBLY



(57) Abstract: A damped steering assembly (10) includes a steering wheel (21) and a steering column (24) connected to the steering wheel (21) and for operative attachment to wheels of the vehicle (12). The damped steering assembly (10) also includes at least one damping element (36) positioned on either one of the steering column (24) and steering wheel (21) to cooperate therewith to damp vibration from the steering assembly (10) of the vehicle (12).

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DAMPED STEERING ASSEMBLY

TECHNICAL FIELD

The present invention relates generally to steering assemblies for vehicles and, more particularly, to a damped steering assembly for a vehicle.

BACKGROUND OF THE INVENTION

It is known to provide a steering assembly for a vehicle wheel for a vehicle that includes a steering wheel connected to a steering column operatively connected to wheels of the vehicle. It is also known that a driver of a vehicle grips the steering wheel to steer the vehicle. It is further known that vibration is generated at the natural frequency of a particular vehicle, which is transmitted through the steering assembly to the driver of vehicle.

One commercial approach to damping the vibration in the steering assembly is to use a mass damper. Currently, the mass damper is about 1.1 Kg to 1.2 Kg of lead and is added to an inside of a hub area of the steering wheel for vibration damping of

the natural frequency of a particular vehicle. However, the mass damper is heavy and adds weight to the vehicle. In addition, the mass damper is not very design and location friendly for designers of the vehicle. Further, the lead material of the mass damper presents a recycling issue at the end of the life of the vehicle.

It is desirable to provide a damper on a steering assembly for a vehicle to damp vibration. It is also desirable to provide a damped steering assembly for a vehicle. It is further desirable to damp vibration in a steering assembly for a vehicle that eliminates the use of lead.

SUMMARY OF THE INVENTION

It is, therefore, one object of the present invention to provide a damped steering assembly for a vehicle.

It is another object of the present invention to provide a steering assembly with a damper that eliminates the use of a mass damper.

To achieve the foregoing objects, the present invention is a damped steering assembly for a vehicle. The damped steering assembly includes a steering wheel and a steering column connected to the steering wheel and for operative attachment to wheels

of the vehicle. The damped steering assembly also includes at least one damping element positioned on either one of the steering column and steering wheel to cooperate therewith to damp vibration from the steering assembly of the vehicle.

One advantage of the present invention is that an improved damped steering assembly is provided with a damper to damp vibration generated by the vehicle. Another advantage of the present invention is that the damped steering assembly eliminates the lead mass damper, thereby reducing weight and cost. Yet another advantage of the present invention is that the damped steering assembly reduces vibration to the driver, thereby improving ride and comfort quality for the driver. Still another advantage of the present invention is that the damped steering assembly has less weight than the lead mass damper and eliminates issues of future recycling of the lead material at the end of the life of the vehicle. A further advantage of the present invention is that the damped steering assembly has ease of design and attachment point freedom. Yet a further advantage of the present invention is that the damped steering assembly has the potential of reducing the weight of the steering assembly by reducing the wall thickness of the magnesium steering column.

Other objects, features, and advantages of the present invention will be readily appreciated, as the same becomes better understood after reading the subsequent description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a damped steering assembly, according to the present invention, illustrated in operational relationship with a vehicle.

Figure 2 is a partial perspective view of the damped steering wheel of Figure 1.

Figure 3 is an elevational view of a damping element of the damped steering assembly of Figure 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings and in particular Figure 1, one embodiment of a damped steering assembly 10, according to the present invention, is shown for a vehicle (partially shown) such as a motor vehicle, generally indicated at 12. The motor vehicle 12 includes an engine compartment 14 and occupant compartment 16. The occupant compartment 16 is accessible via a door 18 and includes a seat 20 in

which an occupant, namely the driver, may sit. The damped steering assembly 10 includes a steering wheel 21 spaced from an instrument panel 22 in the occupant compartment 16. The damped steering assembly 10 includes a steering column 24 connected to the steering wheel 21 and extending through the occupant compartment 16 into the engine compartment 14. The steering column 24 includes a shifting lever 26 used to control a transmission (not shown) of the motor vehicle 12. It should be appreciated that the steering column 24 is operatively connected to wheels (not shown) of the vehicle. It should also be appreciated that an operator's hands (not shown) typically grip the steering wheel 21 to guide the vehicle 12 in the desired direction.

As illustrated in Figures 1 through 3, the steering wheel 21 includes a frame 28 that defines the shape of the steering wheel 21. Preferably, the frame 28 is made from a metal material such as magnesium. The steering wheel 21 includes a hub or inner rim 29, an outer rim 30 circumscribing the inner rim 29 and at least one spoke 32 interconnecting the inner rim 29 with the outer rim 30. The inner rim 29, outer rim 30, and spoke 32 form an integral and one-piece frame 28 for the

steering wheel 21. It should be appreciated that the frame 28 is conventional and known in the art.

The steering wheel 21 also includes a padding member 34 that encloses the frame 28. The padding member 34 cushions the frame 28 to enhance the comfort of the steering wheel 21 for the operator's hands. In this example, the padding member 34 is a cushioning material such as urethane. Advantageously, the padding member 34 may be molded. It should be appreciated that the padding member 34 is conventional and known in the art.

The steering column 24 is generally rectangular in shape and is a hollow member extending longitudinally. Preferably, the steering column 24 is made from a metal material such as magnesium. The steering column 24 is connected at an upper end to the inner rim 29 of the steering wheel 21 by suitable means such as fasteners (not shown). The steering column 24 is operatively connected at a lower end to wheels (not shown) of the vehicle 12. It should be appreciated that the steering column 24 is conventional and known in the art.

The damped steering assembly 10 also includes at least one, preferably a plurality of damping elements 36 positioned on the steering column 24 or on the frame 28 of the steering wheel 21

between the frame 28 and the padding member 34. The damping element 36 is of a piezoelectric type. An example of the damping element 36 is disclosed in U.S. Patent Nos. 5,656,882 and 5,687,462 to Lazarus et al. and assigned to Active Control Experts, Inc., of Cambridge MA, the disclosures of which are hereby incorporated by reference. The damping element 36 is a QUICKPACK® piezoelectric actuator which is commercially available from Active Control Experts, Inc. The damping element 36 is a generally planar member that extends longitudinally and transversely a suitable amount to a desired surface area of the steering column 24 or steering wheel 21. The damping element 36 includes a conductor 38 disposed on a film 40 and a connector 42 disposed on the film 40 and connected to the conductor 38. The damping element 36 is attached directly onto a surface of the steering column 24 or outer rim 30 of the frame 28 by suitable means such as an adhesive. Preferably, a plurality of damping elements 36 are attached to opposed locations on the steering column 24 or the outer rim 30 of the steering wheel 21.

The alarmed steering wheel 10 further includes a power source, such as the controller 44, electrically connected by wires 46 to each of the damping elements 36. The controller 44 has an

amplifier and control (not shown) to apply a voltage to the damping elements 36 to produce active damping. The wires 46 each have a terminal end connector (not shown), as is conventional in the art, that interconnects with the connector 42 of the damping element 36.

In operation, the vehicle 12 produces vibration, which is generated at the natural frequency of the particular vehicle 12, for example between 37 Hz to 38 Hz, at engine idle position. In the damped steering assembly 10, the controller 44 applies a voltage to the damping elements 36 which cause them to bend and displace. The displacement of the damping elements 36 causes active damping of the vibrations in the steering column 24 or steering wheel 21 to a reduced level, for example, 20 dB reduction in free vibration of the steering wheel 21 and 15 dB reduction when the operator's hands grip the steering wheel 21. It should be appreciated that the number and location of the damping elements 36 can be varied for different reduction levels of the vibration. It should also be appreciated that the damping elements 36 could also be used as sensors for detecting catastrophic failure of the steering column or steering wheel 21.

The present invention has been described in an illustrative manner. It is to be understood that the terminology, which has been used, is intended to be in the nature of words of description rather than of limitation.

Many modifications and variations of the present invention are possible in light of the above teachings. Therefore, within the scope of the appended claims, the present invention may be practiced other than as specifically described.

CLAIMS:

1. A damped steering assembly for a vehicle comprising:

a steering wheel;

a steering column connected to said steering wheel and for operative attachment to wheels of the vehicle; and

at least one damping element positioned on either one of said steering column and said steering wheel to cooperate therewith to damp vibration from said steering assembly of the vehicle.

2. A damped steering assembly as set forth in claim 1 wherein said at least one damping element is attached directly to a surface of said steering column.

3. A damped steering assembly as set forth in claim 1 wherein said at least one damping element is attached directly to a surface of a frame of said steering wheel.

4. A damped steering assembly as set forth in claim 3 wherein said steering wheel includes

a frame having an outer rim, said at least one damping element being located on said outer rim.

5. A damped steering assembly as set forth in claim 1 wherein said at least one damping element comprises a film and a conductor disposed on said film.

6. A damped steering assembly as set forth in claim 1 wherein said steering column is made of a metal material.

7. A damped steering assembly as set forth in claim 6 wherein said metal material is magnesium.

8. A damped steering assembly as set forth in claim 1 including an adhesive to attach said at least one damping element to a surface of said steering column.

9. A damped steering assembly as set forth in claim 4 wherein said frame is made of a metal material and including an adhesive to attach said at least one damping element to a surface of said frame.

10. A damped steering assembly as set forth in claim 9 including a controller electrically connected to said at least one damping element to apply a voltage thereto to produce active damping.

11. A damped steering assembly for a vehicle comprising:

a steering wheel including a frame made of a first metal material;

a steering column connected to said steering wheel and for operative attachment to wheels of the vehicle, said steering column being made of a second metal material; and

a plurality of damping elements positioned on either one of said steering column and said frame of said steering wheel to cooperate therewith to damp vibration from said steering assembly of the vehicle.

12. A damped steering assembly as set forth in claim 11 wherein said damping elements are attached directly to either one of a surface of said frame and said steering column.

13. A damped steering assembly as set forth in claim 11 wherein said frame has an outer

rim, said damping elements being located on said outer rim.

14. A damped steering assembly as set forth in claim 13 wherein damping elements are located on both said steering column and said frame.

15. A damped steering assembly as set forth in claim 11 wherein each of said damping elements comprises a film and a conductor disposed on said film.

16. A damped steering assembly as set forth in claim 15 including a controller electrically connected to said conductor of said damping elements to apply a voltage thereto and cause said damping elements to actively vibrate.

17. A damped steering assembly as set forth in claim 11 including an adhesive to attach said damping elements to either one of a surface of said frame and said steering column.

18. A damped steering assembly as set forth in claim 11 wherein said first metal material and said second metal material is magnesium.

19. A damped steering assembly for a vehicle comprising:

a steering wheel including a frame made of a first metal material;

a steering column connected to said steering wheel and for operative attachment to wheels of the vehicle, said steering column being made of a second metal material;

a plurality of damping elements positioned on either one of said steering column and said frame of said steering wheel and adhesively attached thereto; and

a controller electrically connected to said conductor of said damping elements to apply a voltage thereto and cause said damping elements to actively vibrate to damp vibration from said steering assembly of the vehicle.

20. A damped steering assembly as set forth in claim 19 wherein said first metal material and said second metal material is magnesium.

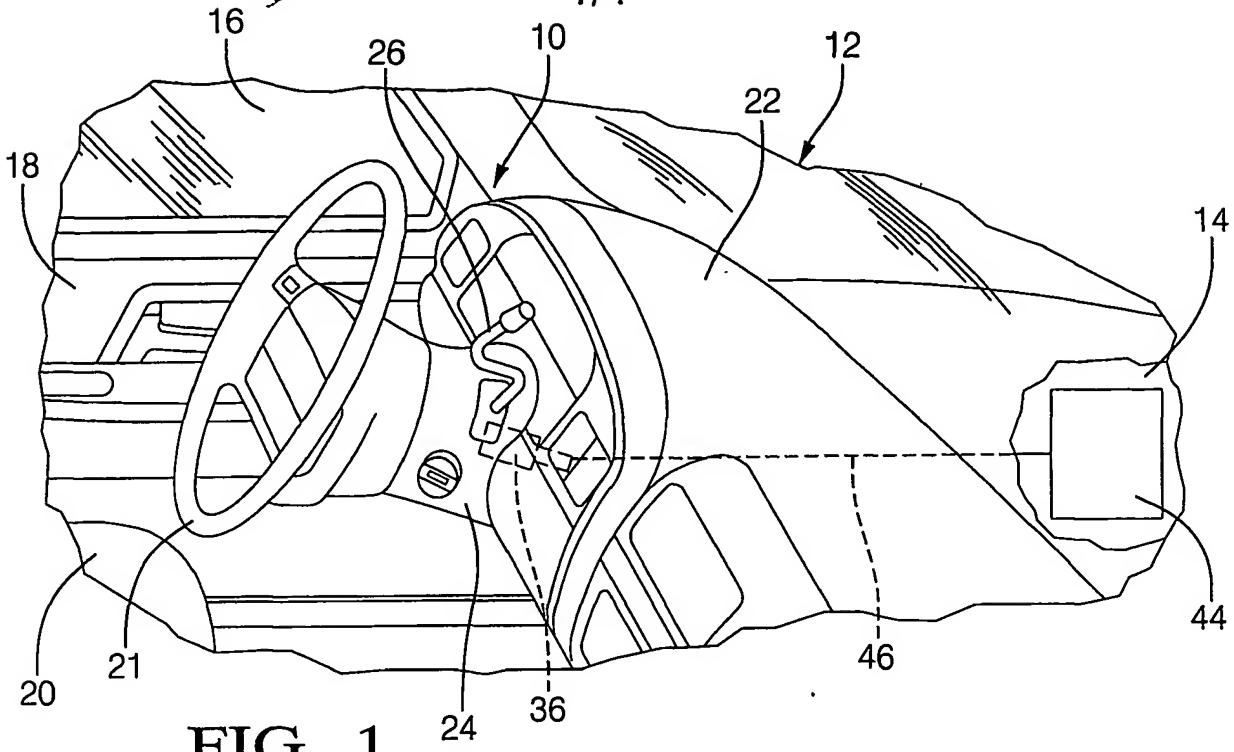

FIG. 1

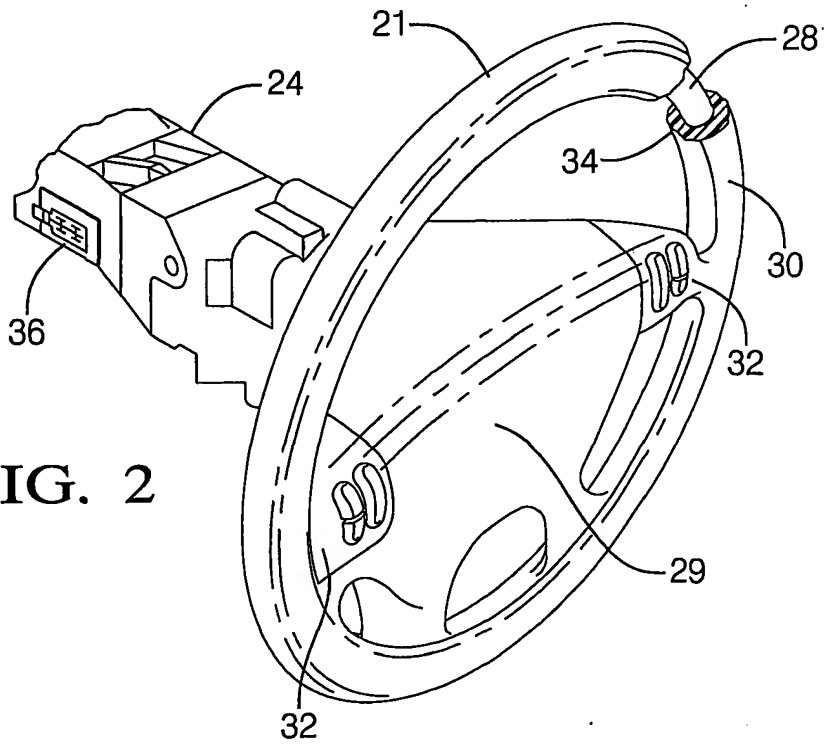

FIG. 2

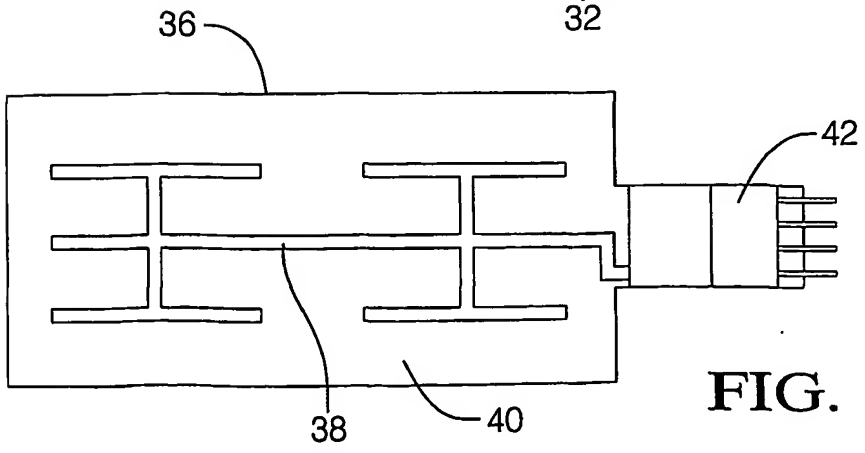

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/23204

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : B62D 1/16,1/04; H01L 41/04; F16F 7/10
US CL : 74/492,552; 310/317
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 74/492,552; 188/378; 310/316.01,317,338

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EAST - search terms 188/$, damper, piezo$, magnesium, steering column, steering wheel, surface

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,517,854 A (KAWABATA et al.) 21 May 1985 (21.05.1985), figure 1.	1,2
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Y		3-20
Y	JP 2000-16300 A (HONDA MOTOR CO.) 18 January 2000 (18.01.2000) figures 1,2	3-5,9,10,15,16,19,20
Y	US 3,726,152 A (TSUNEIZUMI) 10 April 1973 (10.04.1973), figures 1,2, column 2, lines 4-7.	4,9,10,13,14
Y	US 5,788,278 A (THOMAS et al.) 04 August 1998 (04.08.1998), column 2, lines 20-24.	6,7,11-20
Y	US 5,782,140 A (KOYAMA et al.) 21 July 1998 (21.07.1998), column 1, lines 11-14.	11-20
Y, P	US 6,240,866 B1 (NAKATSUJI) 05 June 2001 (05.06.2001), column 4, lines 7-13.	8-10,17-20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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